

**METRIC**

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SECTION 532

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**SUPERSEDING**

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SECTION 101

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**MILITARY STANDARD**

**INTERFACE STANDARD FOR  
SHIPBOARD SYSTEMS**

**SECTION 532**

**COOLING WATER FOR SUPPORT OF  
ELECTRONIC EQUIPMENT  
(METRIC)**



FSC 1990

DOD-STD-1399 (NAVY)  
SECTION 532  
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DEPARTMENT OF THE NAVY

WASHINGTON, DC 20362

Interface Standard for Shipboard Systems,  
Cooling Water for Support of Electronic  
Equipment

DOD-STD-1399 (NAVY)  
SECTION 532

1. This Military Standard is approved for use by all interested Commands of the Department of the Navy in the technical development plans, design, and procurement specifications for new ship acquisitions, ship modernizations or conversions, and systems/equipment for installation therein and into active fleet ships where applicable, and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

FOREWORD

Purpose. This section defines the standard interface requirements for, and the constraints on, the design of shipboard electronic equipment which will utilize the ship's electronic cooling water system.

Nature of the interface. Navy ships have a requirement for cooling water to support electronic equipment. This is provided by a system specifically designed to supply the necessary quantities of conditioned water with standard characteristics. Cooling water is centrally generated and then distributed throughout the ship to satisfy the needs of the various users. This section provides guidance to ensure compatibility between each user and the cooling water system involved and for the documentation of user requirements to assist in the design of such cooling water systems.

Structure. The technical content first describes the characteristics of the shipboard electronic cooling water system in terms of purity, temperature, pressure, and flow rate. Constraints on user systems and the requirements for documentation of user needs are then established.

Numerical quantities. Numerical quantities stated in this section are expressed in metric (SI) units and may be followed by inch-pound units in parentheses. The SI equivalents of the inch-pound units are approximated to a practical number of significant figures. Where parenthetical values are given in inch-pound units, the inch-pound units are to be regarded as the current specified magnitude.

DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

## CONTENTS

		<u>Page</u>
Paragraph	1. GENERAL, SCOPE, INTERFACE, AND APPLICABILITY .....	1
	1.1 General .....	1
	1.2 Scope .....	1
	1.3 Interface .....	1
	1.4 Applicability .....	1
	2. REFERENCED DOCUMENTS .....	1
	2.1 Issues of documents .....	1
	3. DEFINITIONS .....	2
	3.1 Shipboard electronic cooling water system .....	2
	3.2 User equipment .....	2
	4. REQUIREMENTS .....	2
	4.1 Requirements .....	2
	5. INTERFACE CHARACTERISTICS AND CONSTRAINTS .....	2
	5.1 General considerations .....	2
	5.2 Interface characteristics .....	2
	5.2.1 Purity .....	2
	5.2.2 Temperature .....	2
	5.2.3 Pressure .....	3
	5.2.4 Flow rate .....	3
	5.3 Interface constraints .....	3
	5.3.1 Compatibility .....	3
	5.3.2 Pressure drop .....	3
	5.3.3 External connections .....	3
	5.3.4 Materials .....	3
	5.3.5 User cooling water requirements .....	3
	6. DOCUMENTATION REQUIREMENTS .....	3
	6.1 DD Form 1423 .....	3
	7. DEVIATIONS .....	4
	7.1 Conditions .....	4
	7.1.1 Deviation procedure .....	4
FIGURES		
Figure	1. Interface .....	1
	2. Sample format for reporting cooling water require- ments .....	5

DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

## 1. GENERAL, SCOPE, INTERFACE, AND APPLICABILITY

1.1 General. The policies and procedures established by DOD-STD-1399 are mandatory. This section and the basic standard is to be viewed as an integral single document.

1.2 Scope. This section establishes interface requirements for shipboard electronic equipment utilizing the cooling water support system to ensure compatibility between such equipment and the cooling water support system.

1.3 Interface. Basic characteristics and constraint categories concerned with this interface are shown symbolically on figure 1 (see section 3 "Definitions" of DOD-STD-1399):

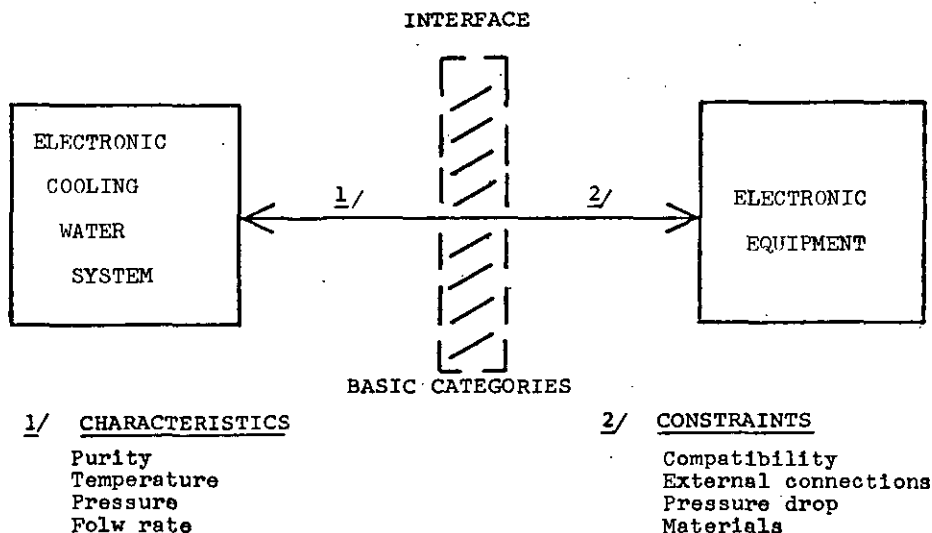


FIGURE 1. Interface.

The particular interface characteristics and constraints pertinent to this section are described in 5.2 and 5.3.

1.4 Applicability. Shipboard considerations require an integrated thermal design for electronic equipment in order to properly dispose of generated heat. The thermal design criteria contained in MIL-E-16400 shall be used for guidance as to the applicability of water cooling.

## 2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this standard to the extent specified herein.

### SPECIFICATIONS

#### MILITARY

- MIL-E-16400 - Electronic, Interior Communication and Navigation Equipment, Naval Ship and Shore: General Specification for.
- MIL-W-21965 - Water Cooling of Shipboard Electronic Equipment; General Specification for.
- MIL-H-24520 - Hose and Hose Assembly for Water Cooling of Electronic Equipment.

DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

## STANDARDS

### MILITARY

- MIL-STD-438 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Submarine Service.
- MIL-STD-777 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Surface Ships.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

## 3. DEFINITIONS

3.1 Shipboard electronic cooling water system. A shipboard electronic cooling water system supporting electronic equipment is a system specifically designed to remove heat from electronic equipment by supplying necessary quantities of conditioned water with standard characteristics as specified herein.

3.2 User equipment. A user equipment is any electronic system or equipment which utilizes the shipboard electronic cooling water system.

## 4. REQUIREMENTS

4.1 Requirements. The specific interface requirements and constraints established herein are mandatory and shall be adhered to by SYSCOMs, Project managers, contractors, and all others engaged in any aspect of shipboard electronic cooling water system design to which these requirements and constraints apply including equipment design, production, and installation (see section 4, "Requirements" of DOD-STD-1399).

## 5. INTERFACE CHARACTERISTICS AND CONSTRAINTS

5.1 General considerations. Shipboard electronic equipments generate heat during their normal operations. This heat must be removed to prevent damage to heat critical components. Heat removal may be by natural dissipation, air cooling, or where these measures are not adequate to remove the required amount of heat, by a centralized electronic cooling water system. This section concerns the centralized cooling water system, as specified in MIL-W-21695, composed of the necessary pumps, heat exchangers, demineralizers, water flow controls, pressure relief valves, temperature regulating valves, temperature, flow and pressure indicators, conductivity indicators, alarms, air trap and expansion tank, stop valves, piping and all other accessories required to insure a continuous flow of cooling water of specified characteristics to the electronic equipment. Cooling of water for the electronic cooling water system is via heat exchangers using water from the sea water system or the chilled water system.

5.2 Interface characteristics. The interface characteristics of the ships cooling water system are described in 5.2.1 through 5.2.4. Each shipboard system will deliver cooling water with these characteristics to the electronic equipment interface. Distilled water, 0.065 equivalents per million (epm) chlorides maximum, will normally be used for filling of electronic cooling water systems.

5.2.1 Purity. The purity characteristics will be as follows:

- (a) Conductivity: Not in excess of 2.0 microsiemens per centimeter ( $\mu\text{S}/\text{cm}$ ) (micromhos per centimeter) corrected to 25°C (77°F).
- (b) Oxygen concentration: 0.5 parts per million (p/m) by weight maximum.
- (c) Filtration: Size of solids will not exceed 0.5 micrometers. Full flow filtration will be provided if required by the electronic equipment.

5.2.2 Temperature. The temperature of the cooling water provided to the electronic equipment inlet connections will be not greater than 40°C (105°F) on surface ships, and not greater than 35°C (95°F) on submarines. The cooling water system can easily provide water at higher temperatures if required in special cases, and when operating in cold sea water, lesser temperatures may be available. The ability of electronic equipment to use water at a temperature not greater than 40°C (105°F) on surface ships and 35°C (95°F) on submarines is extremely critical because of the added cost involved in supporting any requirement less than these temperatures. Such requirement will involve the use of chilled water from the air conditioning system in lieu of the use of sea water for the heat exchanger. This will

DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

require significant increases in cost, weight, space, and a potential compromise in reliability of the air conditioning system. Any need to deviate from this temperature interface characteristic shall be fully justified (see 7.1).

5.2.3 Pressure. The water pressure will be within the range of 69 kilopascals (kPa) (10 pounds per square inch (lb/in<sup>2</sup>)) to 758 kPa (110 lb/in<sup>2</sup>). The equipment cooling system shall be capable of withstanding a hydrostatic pressure test of 1034 kPa (150 lb/in<sup>2</sup>).

5.2.4 Flow rate. The flow rate will be as required by the electronic equipment and controlled by the design of the equipment water passages. Water flow and distribution as described in MIL-W-21965 shall be used for guidance.

5.3 Interface constraints. The interface characteristics of the shipboard electronic cooling water system impose certain constraints on the design of electronic equipment utilizing such support. These constraints are specified in 5.3.1 and through 5.3.5.

5.3.1 Compatibility. The design of electronic equipment utilizing ships cooling water support shall be compatible with the interface characteristics given in 5.2.

5.3.2 Pressure drop. The maximum pressure drop from inlet to outlet of each electronic cabinet shall not exceed 69 kPa (10 lb/in<sup>2</sup>). However, state-of-the-art breakthrough is required in certain tube designs (e.g., klystron tube) in order to stay within the maximum 69 kPa (10 lb/in<sup>2</sup>) pressure drop. While a high pressure piping system required to support large pressure drops is not desirable from the point of view of the additional weight and cost involved, when weighed against the probability and cost of the state-of-the-art breakthrough in tube design, it may be a cost-effective compromise and a deviation from this interface constraint may be indicated. In such instance, the need to deviate from this pressure drop interface shall be fully justified (see 7.1).

5.3.3 External connections. Each unit shall have a single supply and single return water connection for attachment to the electronic cooling water system. The two connections, for rigidly-mounted equipments, shall be union joints or flanges in accordance with Category C-1 of MIL-STD-777 for surface ships or Category N of MIL-STD-438 for submarine service and shall be rigidly fastened to the outside surface of the enclosure. Shock mounted equipments shall be provided with hose assemblies in accordance with MIL-H-24520.

5.3.4 Materials. The coolant circuit shall be constructed of high-purity copper materials which are electrochemically compatible with the materials listed in Category C-1 of MIL-STD-777 for surface ships or Category N of MIL-STD-438 for submarine service. Materials containing carbon are not acceptable.

5.3.5 User cooling water requirements. The cooling water requirements of each user system/equipment shall be reported as specified in 6.1.

## 6. DOCUMENTATION REQUIREMENTS

6.1 DD Form 1423. Where this standard is invoked in direct Government procurements or on a prime contractor who must obtain the data for contractor-furnished equipment (CFE) from his subcontractor, the following data requirements, as applicable, shall be specified by the Principal Development Activity (PDA) on DD Form 1423 (Contract Data Requirements List) attached to the contract or order. Data Item Description UDI-S-23272 may be cited in the DD Form 1423, blocks 2 and 4, as appropriate, with suitable further identification of the particular data item in block 3. The Naval Ship Engineering Center, Auxiliary Water and Compressed Gases Section, shall be included in the distribution listed in block 14 of DD Form 1423 for data specified.

(a) Cooling water requirements - individual user equipment. This documentation applies to each user equipment (see 3.2) which will utilize cooling water from a shipboard electronic cooling water system. It shall include the following information:

- (1) Nominal operating pressure - kPa (lb/in<sup>2</sup>).
- (2) Maximum operating pressure - kPa (lb/in<sup>2</sup>).
- (3) System design pressure - kPa (lb/in<sup>2</sup>).

DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

- (4) Flow rate - liters per minute (L/min) (gallons per minute (gal/min)) (average per unit).
- (5) Flow rate - L/min (gal/min) (maximum per unit).
- (6) Purity.<sup>1/</sup>
- (7) Temperature.<sup>1/</sup>

<sup>1/</sup>If incompatible with standards specified in 5.2.1 and 5.2.2.

- (b) Cooling water requirements - total ship. This documentation applies to the total ship electronic cooling water support system. It shall include the following information:

- (1) User equipment identification.
- (2) Number installed.
- (3) Nominal operating pressure - kPa (lb/in<sup>2</sup>).
- (4) Maximum operating pressure - kPa (lb/in<sup>2</sup>).
- (5) System design pressure - kPa (lb/in<sup>2</sup>).
- (6) Total flow rate - L/min (gal/min).
- (7) Use factor (percent).
- (8) Purity.<sup>1/</sup>
- (9) Temperature.<sup>1/</sup>

<sup>1/</sup>If incompatible with standards specified in 5.2.

6.1.1 A sample format for reporting the information specified in 6.1 is shown on figure 2.

## 7. DEVIATIONS

7.1 Conditions. In achieving the purpose of this section, it is recognized that there must be some flexibility of application. During the early design stage of shipboard electronic equipment utilizing the shipboard electronic cooling water system, it may become apparent that significant advantages in the overall design/operation of such equipment can be achieved by deviating from the standard characteristics specified herein. In such instance, the provisions of section 6, "Deviations" of DOD-STD-1399 shall be complied with.

7.1.1 Deviation procedure. Request for deviations shall be submitted to the Naval Sea Systems Command with copies to:

- (a) Program/Project manager.
- (b) NAVSEC 6154.

User activity:  
AS

Preparing activity:  
Navy - SH  
(Project 1990-N021)



SHIP . . . . .

SUBSYSTEM . . . . .

IDENTIFICATION (USER EQUIP)	NUMBER INSTAL- LED	PRESSURE kPa (lb/in <sup>2</sup> )			FLOW RATE L/min (gal/min)			USE FACTOR (percent)			OTHER REQUIREMENTS (TEMP., PURITY, etc.)
		NOMINAL OPERAT- ING	MAXIMUM OPERAT- ING	SYSTEM DESIGN	AVER- AGE PER UNIT	TOTAL	MAXI- MUM PER UNIT	TOTAL	NORMAL OPS	GQ	
<p style="font-size: 48pt; opacity: 0.5;">SAMPLE</p> <p>NOTE: Entries not applicable to data specified in 6.1(a) for an individual equipment may be left blank.</p>											

FIGURE 2. Sample format for reporting cooling water requirements.

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DOD-STD-1399 (NAVY)  
SECTION 532  
10 May 1978

